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ABSTRACT

Proposal of a high Reliability BGA Package Technology using Intensive Pulsed Light Energy

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The net zero commitment calls for reducing energy consumption in semiconductor manufacturing by 2050. According to the McKinsey & Company report 2021, the semiconductor industry's CO2 ratio of process current and standby current accounts for more than 80%. In other words, the semiconductor industry consumes very high current compared to other industries. For example, as a mobile phone is assembled with more than 1,000 components such as active and passive components, the electronic package is becoming denser and faster in performance, and the electrical and mechanical properties must be more stable and reliable. Convectional reflow soldering is a typical technology in the electronic package manufacturing process, but for example, the soldering process using SAC 305 solder alloy is known to consume high energy of 29.5kWh and the process requires high temperatures of more than 240°C and long process time for 300 seconds. Therefore, the reflow soldering process causes many problems, such as delamination between solder alloys and PCB substrate during the soldering process, short circuit failure between fine electrodes, and warpage of package etc.
Meanwhile, laser-assisted bonding (LAB) has been highlighted as an advanced soldering process with ultra-high-speed bonding process and thermal selectivity. However, laser energy may have limitations in the application of soldering process for local bonding or point soldering using a single-wavelength laser beam. Our team proposed IPL soldering because it has many advantages such as process time reduction (1/10), warpage problems of packaged components, and thermal damage of packages. In this presentation, we evaluated the shear strength and microstructure of solder ball joints assembled with different soldering energies such as IR energy for reflow soldering, laser energy for LAB, and Xe energy for IPL soldering. The reliability of BGA packages manufactured by reflow process and IPL soldering was evaluated using shear test method and drop impact test method, respectively. The shear strength of solder ball joints by IPL soldering was higher than those by reflow soldering and LAB due to the thinner layer of intermetallic compound (IMC). The drop impact strength of BGA packages through the IPL process was 3 to 5 times higher than that of convection reflow. Cracks in BGA packages on OSP surface finished PCB substrates propagated mainly along the Cu6Sn5 layer formed at the BGA package

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Reference

[1] E.Ha and S. B. Jung et al, Advanced Engineering Materials, 5, 25, 2201635 (2023).